Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170511 Date:19-12-2023

Subject Name: Transport Phenomena

Time: 10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	State the general equations that govern any transport process.	**03**
	(b)	Cite the reasons for studying Transport Phenomena.	**04**
	(c)	State and discuss the various levels of transport phenomena studies in detail.	**07**
Q.2	**(a)**	Compute the steady-state momentum flux τ_{yx} in N/m^2? When the lower plate velocity v is 1 ft/s in the positive x direction, The distance Y between the two parallel plates is 0.001 ft, and the fluid viscosity μ is 0.7 cp.	**03**
	(b)	Discuss about the conservation laws.	**04**
	(c)	Discuss with appropriate equation and schematic representation about the molecular transport of momentum.	**07**
		OR	
	(c)	Derive the relation for velocity distribution for flow through a circular tube	**07**
Q.3	**(a)**	Compare thermal conductivity, thermal diffusivity and heat capacity in terms of dimensionless number.	**03**
	(b)	State the commonest of boundary conditions in molecular energy transport.	**04**
	(c)	Discuss in brief pressure and temperature dependence of viscosity depicting appropriate equations.	**07**
		OR	
Q.3	**(a)**	State the shell momentum balance equation?	**03**
	(b)	Define mass and molar average velocities.	**04**
	(c)	State and discuss the procedure for setting up and solving viscous flow problems with reference to velocity distributions in laminar flow.	**07**
Q.4	**(a)**	Compute the thermal conductivity of molecular oxygen at low pressure and 300 K. The Lennard-Jones constants for molecular oxygen are $\boldsymbol{\sigma}$ = 3.433 A^o and ε/K = 113 K, and its molecular weight M is 32, and Ω_k= 1.074.	**03**
	(b)	Discuss Fourier's Law of heat conduction in brief on the basis of molecular energy transport.	**04**
	(c)	Derive the relation for heat flux distribution for heat conduction with a nuclear heat source.	**07**
		OR	
Q.4	**(a)**	Discuss the significance of momentum, thermal and mass diffusivities.	**03**

(b) Calculate the heat loss per m^2 of surface area for an insulating wall composed of 25.4 mm thick fibre insulating board, where the inside temperature is 352 K and the outside temperature is 297 K. the thermal conductivity of fibre is 0.048 W/m K. **04**

(c) State and discuss the various methods of calculating self diffusivity and binary diffusivity. **07**

Q.5 **(a)** Show that for equimolar counter diffusion $D_{AB} = D_{BA}$ expressed in terms of molecular mass diffusion. **03**

(b) Explain the molecular diffusion in gases with appropriate equations. **04**

(c) Deduce the expression for diffusion with a heterogeneous chemical reaction with appropriate schematic diagram. **07**

OR

Q.5 **(a)** State the shell mass balance equation and boundary conditions used for solving the mass transport problems. **03**

(b) Estimate the diffusion coefficient for acetone in water at 25 ^{O}C using Wilke-Chang equation. The association parameter $\Psi_B = 2.6$, μ for water = 0.8937cp. The atomic volume for C = 14.8 cm^3/gmol, H = 3.7 cm^3/gmol, O = 7.4 cm^3/gmol. **04**

(c) Derive an equation for the diffusion in homogeneous chemical reaction with appropriate schematic diagram. **07**